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(54) Round bale dryer.

(57) Device for a drying process of hay or the like, said hay being in the shape of round bales (4); said device comprises an ambient (1) for collecting drying air, a surface (2) for supporting, in correspondence of openings (3) a plurality of bales to be dried, a grid (7) in correspondence of each opening (3), a plate (8) arranged on each grid (7), said plate (8) being adapted to cooperate with a cover (13) provided with an edge (14), in such a way that every portion of the hay arranged in the bale can be involved by the drying air flow, avoiding that the external middle-high part of the bale remains humid after the drying process, and, therefore, is adapted to deteriorate; due to a fermentation process, loosing its nourishing and organlolectic characteristics for feeding cattle.

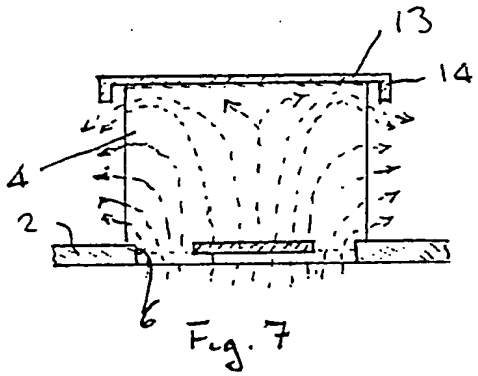

Fig. 7

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ROUND BALE DRYER

The present invention relates to a device for drying hay, said hay being adapted to appear in the shape of pressed bales with a substantially circular base, the pressure inside said bales being increasing from the inside to the periphery, obtaining in such a way so called soft core bales, comprising supporting means for the drying process of said bales, said supporting means being adapted to belong to an ambient for collecting drying air and being provided with a plurality of openings, each one of said openings being adapted to be filled by one of said bales.

Many devices are known for processing hay pressed in the shape of round bales, which devices being able to dry in a rapid and economical way hay bales collected in the field by crop baling machines. Indeed, it is known that hay bales may be stored and ready for feeding cattle just after humidity of the hay is lower than 15-16%, otherwise a degrading process of the hay, as far as nourishing and organolectic substances are concerned, may occur, due to the hay fermentation. Especially for the soft-core bales, which present a lower pressure in the inside of the bales, it is sufficient to involve the bales with a quite dry (with respect to the hay) air flow, in case pre-heated before the ambient where air for the hay process is collected, for starting with a drying process of the bales. The air which enters the bale from bottom, is usually inclined to follow preferential ways, especially the central way in the soft-core bales, i.d. the axial way with reference to the cylindrical shape of the bale. Particu lar expediants are carried, particularly the expedient of a cover, which is placed on the top of the bale and which is provided with an edge around said cover, in such a way that the air is obliged to follow a way, which, especially in correspondence of the top of the bale, involves also the external part of the bale, obtaining a substantially uniform drying process of all the bale. This problem is particularly important, because, if the drying process is uniform in all the bale, time is shorter for a completion of said process, but, consequently, also a cost reduction is obtained, especially energy costs referred to the fan and heat exchanger for the drying air. It is not to be disregarded that, with an optimal device as far as an omogeneous drying process of all the bale to be dried is obtained, also the device manufacturing costs are decreased, either because the dried bale production is increased under the same conditions, or dimensions can be reduced, with the same bale production.

The technical problem which the device according to the invention intends to solve is to allow the drying process to involve in an omogeneous way the hay placed in any part of the bale, particularly the hay which is arranged in correspondence of the middle-external part of the bale, i.d. in the middle part between the bottom and the top of the bale. Indeed, experiences suggests that the bottom of the bale is well dried, also in absence of particular expedients, it is sufficient that supporting surface on the circular opening of the frame is airtight, in such a way that air can't escape from the bottom. At contrary, as far as the top is concerned, it could be sufficient to use a cover, in case provided with an edge. The critical part of the bale is always the external middle-high of the bale.

This problem is solved by the device according to the inventions, which is characterized by interdictions means (8), said interdiction means being placed on grids (7), said grids being connected in correspondence of each one of said openings (3) on said supporting means (2), in such a way that drying process involves involves in a homogeneous way the hay arranged in any part of the bale, particularly the hay arranged in the external, middle-high part of each bale.

These and further features will be apparent from the following description and in enclosed drawings, where:

Fig. 1 represents a perspective view of the device according to the invention;

Fig. 2 represents a plan view of the same device, on which some bales of hay were arranged;

Fig. 3 represents a sectional view, according to the line A-A of Fig. 2;

Fig. 4 rapresents a sectional view according to the line B-B of Fig.2;

Fig. 5 rapresents a sectional view according to the line C-C of Fig.2;

Fig. 6 represents a sectional view according to the line D-D of Fig.2;

Fig. 7 represents a sectional view according to the lineE-E of Fig.2;

Fig. 8 represents, with its articulations into 8a, 8b, 8c three differents embodiments of a particular of the device according to the invention.

DESCRIPTION

The device according to the invention comprises an ambient 1 for the collection of the drying air, which is processed, before this ambient, by an heat-exchenger and by a fan, non represented in the drawings. The ambient 1 (Figg.1 and 2) comprises a surface 2, which represents supporting

means of the device according to the invention. On said surface 2 a plurality of bales 4 of hay are adapted to be arranged, in corrispondence of the same number of openings 3. Fig.2 represents a plurality of bales 4, each one provided with particulars, which will be expained forward. It is known that the humidity of the hay collected in the field may arrive till 50-60% whereas its optimal value for storing hay to be used as cattle food, should usually be comprised between 15 and 16%. otherwise a degrading process, due to the hay fermentation, may occur. Each opening 3 is provided with a recess 6 (Fig.3); its height is limited, with respect to the plan of the surface 2, by a grid 7 (Fig.1), which has two main functions: the first one is to allow a tractor to de be driven free on the surface 2 in order to load on and to unload from the hay bales 4; the second one is to allow a bale 4 to stop, with its internal part of bottom, on the same grid and with its external part of bottom on the surface 2, obtaining in such a way an air tight result, like it will be explained forward. On the grid 7 a substantially plate 8 (Fig. 8a) may be arranged, which may be quite full, or provide with holes 9 (Fig.8b), or with sectors 11 (Fig.8c). The diameter of the plate 8 may be equal to half of diameter of opening 3, which is usually 120 cm. Diameter of the plate 8 is therefore 50-60 cm. Plate 8 represents interdiction means of the device according to the invention. Said dimensions are depending on dimensions of the bale bottom; its standard is usually comprised between 150 and 165 cm. In Fig.8c. the plate is practically made of two plates, one of them lower and connected to the grid 7 and the second adapted to rotate with respect the the fixed plate, so that it is possible to adjust, with said rotation, the width of sectors 11. On the top of the bale 4 a cover 13 may be arranged. Cover 13 is circular and its dimensions are a bit bigger than diameter of the bale top. For instance, its diamater might be 170-180 cm. in the case of bale diamater 150 cm. Cover 13 may be provided with an edge 14, all around the cover 13. Height of the edge 14 may be substantially equal to 0,1 diamater of cover 13, i.d. 17-18 cm. Cover 13 and edge 14 make the airf flow deviate, in order to involve a bigger quantity of hay. Instead of cover 13 with edhe 14, a cover 16 (Fig.6) may be useful to be arranged. Its shape is always circular, but its diameter may be lower that top diameter of the bale, substantially comprised between 90 and 120 cm. if the bale has a diameter 150 cm. Cover 16 may be provided with an edge 17, all around the cover 17 and having a height comprised between 5 and 8 cm.

It' well known that the most crop baling machines working at present time are producing so-called "soft-core bales", with hay less pressed in the inside of the bale. Crop baling machines, which can produce "hard-core bales" are less utilized. These bales present hay more pressed in the inside than in the external part. Crop baling ma- so called "variable pressure crop baling machines" were recently introduced in the market. They are provived with a hay pressure adjustment device, which operates on the hay pressure during the tamping operation on the hay, in such a way that a result of a substantially uniform pressure of the hay in the inside of tha bale can be obtained. Therefore, the pressure in the inside of the bale is not variable,whereas it is the hay pressure adjustment device which operates in different way during the bale forming process. This type of bale is ideal, as far as the drying process is concerned: indeed the drying air, which involves a bale, is not obliged to follow preferential ways, because it is free to pass through any part of the bale, contrary to what happens in "soft-core" and "hard-core" bales. But the reason why the crop baling machines which produce "soft-core bales" call our attention, is depending on the fact that these machines are less expensive and more diffused than the other ones. Without any particular expedients, drying air which involves a "soft-core bale", is obliged to choose as preferential way which is substantially close to the cylinder axis of the bale. Consequently, two drawbacks happen: the first is that hay placed in correspondence of the side external part of the bale, may present an humidity quite higher than 15-16%, after completion of drying process; the second is that time required for completion of drying process may last more than economical times. In the case a cover 13 is arranged on the bale top,provided with an edge 14, the way preferred by the air flow which involves the bale from bottom, is represented by dashed line in Fig. 3. It is apparent that the most hay which is placed in the median part of the bale is practically just a bit or not dried. If, at contrary, a plate 8 is placed on the grid 7 (Fig.4), said plate being quite complete, i.e. with no holes and with no particular openings, drying air is allowed to flow according ways different from previous case; said ways are indicated in Fig.4.In the case no cover 13 is arranged on the bale 4, the air flow is deviated by cover and involves especially the bale bottom (excepted the bale part immediately higher on the plate) and also a good portion of hay situated on the bale top. As far as the medial part of the bale is concerned, hay us dried less, even over the fixed limit of 15-16% of humidity. In the case action of cover 13 is combined together with action of complete plate 8 (Fig.5), a better involvement of hay distributed into the bale is evaluated, especially in correspondence of the medial part of the bale. As far as the portion of the bale, which is situated immediately over the plate 8, is concerned, it is not involved by the air

flow and fermentation process is starting afterwards, due to the remaining humidity, as soon as drying process is over.

It is necessary to point out the effect of plate 8: drying air, which is fed by fan, comes into the ambient 1 (Fig.1), and it increases pressure in the inside of ambient 1, due to the fact that said air meets with openings 3, which present reduced exit sections: it increases consequently its exit speed through the residual vent of grids 7. Experience proved that just the combined actions of plate 8 and cover 13 are able to produce a drying process, which is substantially uniform in the inside of bale hay, particularly in the portion distri buted in correspondence of median height of the bale. In the second place, the amount of air, which preferentially flows along the way where hay is distributed close to the axis of round bale, is decreased. At last, consequently, the output of drying device is increased and time and operation cost are reduced. In case of bales, which are made of especial material (clover or particularly hard hay), use of plates 8 provided with holes 9 is necessary, so that also the portion of bale immediately above said plate 8 is involved. Experimental data obtained in some farms confirmed that, if 3.000 cubic meters of air are necessary for a complete drying process of a bale of 150 cm. base and 120 cm. height, using a plate 8 together with a cover 13, such an amount of air is reduced to about 2.5000 cube meters, and consequently the drying process cost is reduced to about Lit.1.300 each quintal of hay. Energy saving is to be joined to time saving, with the same device output, or to a reduction of device cost, always with the same device output. Indeed, at present time, costs for hay drying process were about around Lit. 1.500-1.600 each quintal of hay. In the case time required for hay drying process is to be reduced, a cover 16 is arranged on the bale 4, said cover 16 being provived with an edge 17; cover 16 is pressed on the bale top, in the manner that edhe 17 pierces onto the inside of bale 4, with its complete height. The result of drying process appears extremely good, especially with not particularly hard hay (see air flow lines of Fig.6), whereas a further advantage is offered by lower cost and easier handling of cover 16 with respect of cover 13, which is heavier and more cumbersome.

At last, it is necessary to point out that, for a better result of drying process, all the amount of air flow is to be utilized, said air being flowing from the ambient 1. This fact requires that the bale bottom is airtight , avoiding that air escapes outside. This is why the external portion od bale bottom leans on surface 2, whereas the the remaing portion, which represents the most bottom of the bale, is resting on the grid 7.

Claims

1. Device for drying hay, said hay being adapted to appear in the shape of pressed bales with a substantially circular base, the pressure inside said bales being increasing from the inside to the periphery, obtaining in such a way so called soft core bales, comprising supporting means for the drying process of said bales, said supporting means being adapted to belong to an ambient for collecting drying air and being provided with a plurality of openings, each one of said openings being adapted to be filled by one of said bales, **characterized** by interdictions means (8), said interdiction means being connected in correspondence of each one of said openings (3) on the said supporting means (2), in such a way that drying process involves in a homogeneous way the hay arranged in any part of the bale, particularly the hay arranged in the external middle-high part of each bale.

2. Device like in Claim 1, **characterized** by the fact that said interiction means (8) may be made of a plate, said plate being substantially circular and having a diameter substantially equal to half diameter of each opening (3).

3. Device like in Claim 1, **characterized** by the fact that said interdiction means (8) are made of a plate, said plate being substantially circular and being provided of a plurality of holes (9), in such a way that also the hay arranged immediately above said plate (8) could be involved by drying process, in presence of a particularly high humidity of the hay or in presence of a particular quality of the hay.

4. Device like in Claim 1, **characterized** by the fact that said interdiction means (8) are made of two plates, each one of said plates being provided with sectors (11), the first one of said plates being fixed to a grid (7), said grid (7) being integral with said supporting means (2), the second one of said plates being adapted to rotate with respect to said first plate, so that it is possible to adjust the width of said sectors (11) for the adjustment of the amount of drying air throghu said openigs (3).

5. Device like in Claim 1, **characterized** by the fact that said interdiction means (8) are able to cooperate with a cover (13), said cover (13) being adapted to be provived with an edge (14), so that the drying air flow can involve the hay arranged in any parts of said bale, particularly the external middle-high part.

6. Device like in Claims 1 and 5, **characterized** by the fact said cover (13) is substantially circular and its dimensions are a bit bigger than the diameter of the bale top.

7. Device like Claims 1 and 5, **characterized** in that a cover (16) is substantially circular like the bale top, said cover (16) having a diameter sub-

stantially less than bale top, said cover (16) being provided with an edge (17), said edge (17) being arranged all around said cover (17).

8. Device like in Claims 1, 5 and 7, **characterized in** that said covers (13,16) are provided with edges respectively (14,17), so that the drying air flow can be deviated for an involvement of more hay to be dried.

TAV. 1

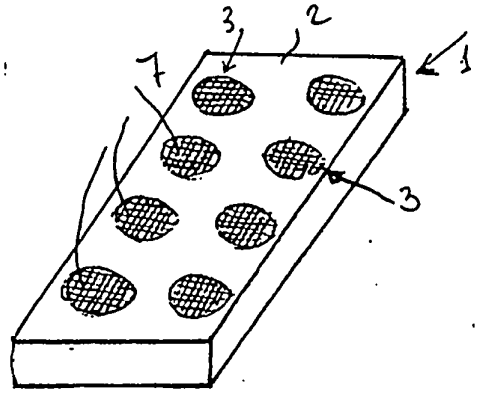


Fig. 1

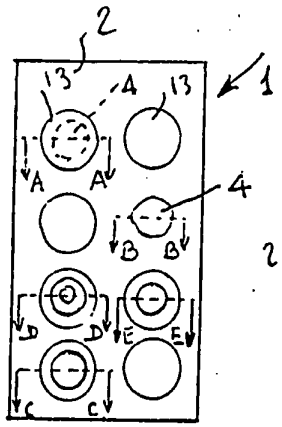


Fig. 2

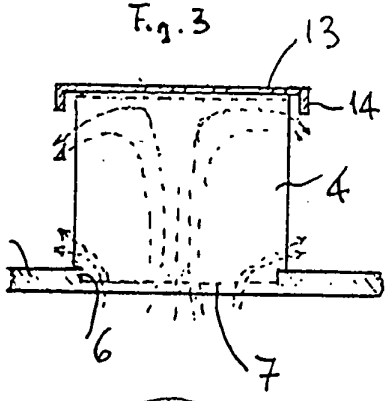


Fig. 3

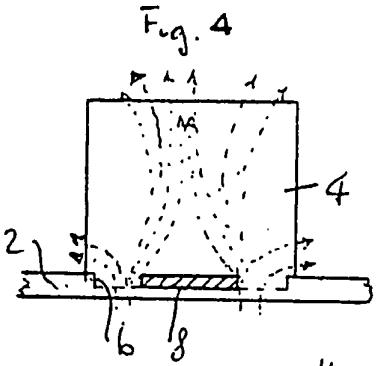


Fig. 4

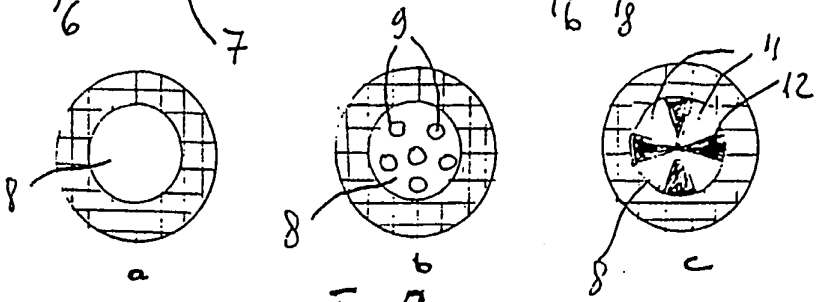


Fig. 8

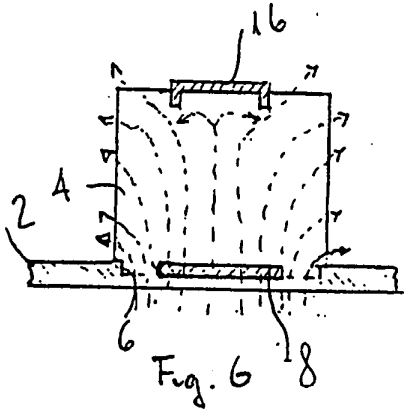
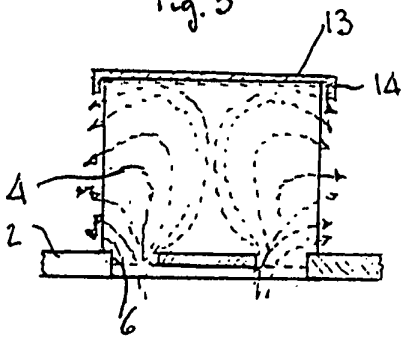


Fig. 6

Fig. 5



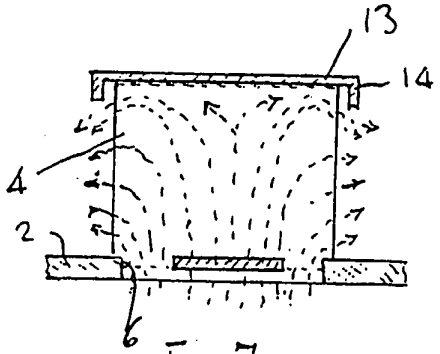


Fig. 7

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